

A new species of the genus *Lycodon* Boie, 1826 from Laos (Squamata: Colubridae)

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Abstract. A new species of the genus *Lycodon* is described from northern Laos. It differs from the superficially similar *Lycodon ruhstrati* by the colouration of the body and venter, the number of bands on body and tail; from the *Lycodon fasciatus* group by the number of the bands, the unbanded venter and the loreal not touching the eye. This new species is only known from the karst hills in Vientiane Province, Laos.

Key words: Oriental Region, Laos, Colubrinae, *Lycodon ruhstrati* group, taxonomy, *Lycodon davidi* spec. nov.

Introduction

The genus *Lycodon* Boie, 1826 currently comprises 35 species and is thus one of the largest snake genera in the Oriental Region (Uetz et al. 2011). Recent reviews of parts of this genus resulted in the description of several new species (Ota & Ross 1994, Vogel et al. 2009, Vogel & David 2010, Vogel & Luo 2011, Zhang et al. 2011). There has never been a review of the genus as a whole, resulting most probably in an underestimation of the number of species included. Beside species described in the frame of revisionary studies which led to the splitting of previously wide-ranging species, some other new species described in this genus had not been met previously (Lanza 1999; Slowinski et al. 2001, Gaulke 2002). Furthermore, these recently described species do not belong to any species complex as currently defined. This is likely due to the nocturnal and secretive activity of many members of this genus.

The genus *Lycodon* is characterized by having a head depressed dorsoventrally, barely set off from body, a relatively small eye with a vertically elliptic pupil, a large nostril, an upper maxillary bone both strongly arched and bent inwards anteriorly, anterior maxillary teeth curved, with a gap between the very large anterior teeth and the subsequent ones, the dorsal scales smooth or feebly keeled in 17, 19, or 21 rows at mid-body, and the ventrals rounded (Malkmus et al. 2002).

During recent field work in Laos, we collected one specimen of *Lycodon* which could not be iden-

tified. Another snake was subsequently observed (A. Teynié, pers. comm., September 2011) but not collected. Due to the presence of significant differences in morphology we refer these specimens to a new species which is here described. This new species is compared with other *Lycodon* species of the region.

Material & Methods

The specimen of the undescribed species is compared with a total of 65 preserved specimens of the complex of *Lycodon ruhstrati* (Fischer 1886) sensu Vogel et al. (2009) and 88 preserved specimens of the complex *Lycodon fasciatus* (Anderson 1879) as defined in Vogel & David (2010). These specimens were examined for external morphological characters and dentition. They are listed in the Appendix I and in Zhang et al. (2011).

A total of 52 morphological characters were recorded for each specimen (see Appendix 2). Not all of these characters were useful to distinguish between species in this study, but all of them were compared because they may be useful for further taxonomic actions.

Measurements, except body and tail lengths, were taken with a slide-caliper to the nearest 0.1 mm; all body measurements were made to the nearest millimetre. The number of ventral scales was counted according to Dowling (1951). Half ventrals were counted as one. The first scale under the tail meeting its opposite was regarded as the first subcaudal, the terminal scute was not included in the number of subcaudals. The dorsal scale rows were counted at one head length behind head, at midbody (i.e., at the level of the ventral plate corresponding to a half of the total number of ventrals), and at one head length before vent. We considered sublabials being those shields that were completely below a supralabial.

Values for paired head characters are given in left / right order.

The pale bands on the body and tail were counted on one side. Hardly visible or incomplete bands were counted as one band; bands that were fused were counted as two. The collar on the neck was not counted and bands covering the cloacal shield were added to the bands of the body. The sex was determined by dissection of the ventral tail base.

Museum abbreviations

AMNH: American Museum of Natural History, New York, USA. – BMNH: The Natural History Museum, London, UK. – CIB: Chengdu Institute of Biology, Chengdu, People's Republic of China. – FMNH: Field Museum of Natural History, Chicago, USA. – IEBR: Institute of Ecology and Biological Resources, Hanoi, Vietnam. – IRSNB: Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium. – MNHN: Muséum national d'Histoire naturelle, Paris, France. – NMW: Naturhistorisches Museum Wien, Vienna, Austria. – QSMI: Queen Saovabha Memorial Institute, Thai Red Cross Society, Bangkok, Thailand. – ZFMK: Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany. – ZMB: Zoologisches Museum für Naturkunde der Humboldt-Universität zu Berlin, Berlin, Germany.

Other abbreviations

SVL: Snout-vent length (mm); TaL: Tail length (mm); TL: Total length (mm); Rel TL: Relative tail length TaL/TL

Results

Lycodon davidi spec. nov.

Holotype. IEBR A.2011.7 (field number NQT 2010.39), male (ventral tail base dissected), from Nam Cave (18°54.597'N, 102°25.998'E, 268 m above sea level), near Ban Muang Song, Vang Vieng District, Vientiane Province, Laos (Figs 1–3, 5, 6), collected by Truong Quang Nguyen and Phouthone Kingsada on 6 May 2010.

Diagnosis. A species of the genus *Lycodon* characterized by: (1) loreal scale not entering orbit; (2) 17 dorsal scale rows at the forepart of the body and 17 dorsal scale rows at midbody; (3) dorsal scale rows keeled; (4) 224 ventrals in the single known male, females unknown; (5) 99 SC in the single known male; (6) a relative tail length of about 0.209 in the single known male (7) 8 supralabials with SL 3–5 touching the orbit; (7) 84 narrow brownish-grey bands on a dark brown body, widening laterally; (8) width of the first band about 1.0 scale on the vertebral row, about 3 ventrals at its base; and (9) the venter heavily dark speckled in the posterior two thirds.

The new species can be recognized by the combination of the loreal scale not entering orbit,

the high number of narrow dorsal bands and especially the high number of bands on the tail and the venter which is heavily speckled in the posterior two thirds. Detailed comparisons with other species of the genus *Lycodon* are provided in the Discussion.

Etymology. This species is named in honour of our friend and colleague Patrick David (MNHN, Paris, France), for his outstanding contributions to the reptile fauna of the Oriental Region.

We suggest the following common names: David's Wolf Snake (English), Davids Wolfszahnatter (German), Rân khuyêt da-vid (Vietnamese).

Habitus. Body elongate; head flattened, distinct from the neck. Eye moderate, with a vertically elliptic pupil.

SVL 308 mm; TaL 81.5 mm; TL 389.5 mm; Rel. TL: 0.209.

Dentition (based on dissected left maxilla). Maxilla arched, with an angulous apex, distinctly bent inwards anteriorly. A total of 11 maxillary teeth or teeth alveola, with the following formula: 4 small anterior teeth, the last one enlarged + 2 strongly enlarged teeth, thick, and not much curved + a wide gap, of about the same length of the largest teeth + 3 small teeth + a small gap + 2 enlarged posterior teeth.

Body scalation. 224 VEN (+ one preventral), 99 SC, cloacal plate single.

Dorsal scales in 17–17–15 rows. Middorsal scale rows slightly keeled, outermost rows entirely smooth throughout body. Vertebral row not enlarged. No apical pit detected.

Head scalation. Rostral triangular, slightly visible from above; nasal completely divided by the nostril; two pentagonal internasals, widely in contact with each other and with prefrontals; two large prefrontals, much larger than internasals; one triangular-shaped frontal, slightly longer than wide, smaller than parietals; 1/1 preocular; 2/2 postoculars (the lower slightly larger); 1/1 loreal, pentagonal, elongated, in contact with second and third supralabials, preocular, prefrontal and postnasal; loreal single, not entering orbit; 8/8 supralabials, second widely bordered with the posterior edge of postnasals, 3rd to 5th SL reaching the eye, 6th largest; 1/1 supraocular; 2 anterior temporals on each side and 3/2 posterior temporals; a paraparietal behind the second row of temporals, surrounded by 7 shields, 3 shields in between the paraparietals; 10/10 infralabials, 1st pair in contact each other, five anterior in contact with the first pair of sublinguals on each side;



Figure 1. Dorsal and ventral views of the preserved holotype of *Lycodon davidi* spec. nov., IEBR A.2011.7 from Nam Cave, Vang Vieng, Vientiane Province, Laos (Photo by T. Ziegler).



Figure 2. Lateral, dorsal, and ventral views of the head of the preserved holotype of *Lycodon davidi* spec. nov., IEBR A.2011.7, from Nam Cave, Vang Vieng, Vientiane Province, Laos (Photo by T. Ziegler).

anterior and posterior pair of sublinguals of about same length, but right posterior sublingual longer than left one and slightly longer than anterior sublingual; anterior pair of sublinguals wider than posterior pair.

Colouration in preservative. The head is olive-brown with somewhat paler regions stretching from behind the eyes towards the end of the occiput. In particular the medial and posterior supralabials are distinctly whitish-cream with brown sutures. At the occiput there is an indiscernible, thin pale V-shaped border towards the visible dark neck band. The dark neck band bears a pale lateral blotch. From behind this dark neck band there are 84 pale dorsal crossbands on the brownish-black body, and 38 pale dorsal crossbands on the likewise dark ground colour of the tail, without counting the band covering the tail tip. The first band on body is starting at the level of 6th ventral, is on the left side 2 ventral-wide and on the right side 4 ventral-wide at its base and 1 dorsal-wide vertebally. These crossbands are widest at the anterior part of the body, where they are about one to two dorsal scale-long, and shortest towards the tail tip, where they are only about one half to one dorsal scale-long. The pale bands slightly widen at their ventrolateral limit and may contain dark pigmentation, which also widen towards the ventro-lateral region, where they become more prominent. Some of the crossbands are irregularly shaped or Y-shaped. In general, the anterior dorsal body bands are broader and more distinctly shaped than the thinner and more irregular formed bands from the second third of the body towards the tail tip. The venter is whitish-cream on the anterior part of body, then intensively speckled with numerous dark brownish-black blotches or crossbars irregularly spread out over the background colour.

For coloration in life see Fig. 3. In life, the light bands on body and tail are rusty infusion of the light crossbands and the posterior part of upper head is ametallic reddish-purple.

Variation. Only one snake was preserved for voucher specimen. The second known specimen was also observed in the limestone hills of Vang Vieng District, Vientiane Province, and had the same general colouration (A. Teynié, Clermont-Ferrand, pers. comm., September 2011).

Distribution. *Lycodon davidi* spec. nov. is currently only known from the limestone region of Vang Vieng District, Vientiane Province, Laos PDR.

Biology. The holotype was found on the forest floor at the entrance of a karst cave at 268 m a.s.l., at about 9.00 PM. The surrounding habitat is evergreen karst forest (Fig. 5). No further information is known on the biology of this species.

Discussion

Based on the key of Lanza (1999) the new species belongs to the complex of *Lycodon ruhstrati*. At the time this key was published, *Lycodon futsingensis* (Pope 1928) was still considered a synonym of *L. ruhstrati*. This taxon was resurrected from synonymy by Vogel et al. (2009) who also described a subspecies for populations of *L. ruhstrati* of the Asian mainland. The nominate form of *L. ruhstrati* was restricted to Taiwan. However, *Lycodon futsingensis* has unkeeled dorsal scales whereas *Lycodon davidi* spec. nov. has keeled dorsal scales (except the outermost rows). The main difference between *L. ruhstrati* (both subspecies are combined here) and *Lycodon davidi* spec. nov. is the colouration and the number of pale bands on the body and tail (Figs. 3 and 4). In *Lycodon ruhstrati* the bands are brownish-grey, while in *Lycodon davidi* spec. nov. they are more vividly coloured with hues of pink and brown, much narrower, and the number is considerably higher (84 vs. 19–47 on body [n = 38] and 34 vs. 10–25 on tail [n = 32]). The first band starts at ventral 6, whereas it is starting at ventral 8–17 in *L. ruhstrati*. In *Lycodon davidi* spec. nov. the venter is uniform in the first part up to about ventral 42. In *L. ruhstrati* the whole venter is usually uniform with few speckles, in some specimens the posterior part might be more speckled as well but the nearly uniform part extends at least up to ventral 120. The speckling is never as intense as in *Lycodon davidi* spec. nov. In juvenile of *L. ruhstrati*, the belly is more or less uniform.

The most similar species to *Lycodon davidi* spec. nov. is *Lycodon multifasciatus* (Maki 1931). This species is known from the Ryukyu Islands, south of Japan, quite far away from the type locality of *Lycodon davidi* spec. nov. and in a distinct biogeographical region. Therefore conspecificity would not make sense from a zoogeographical point of view. Furthermore, *L. multifasciatus* differs in having more subcaudals in males (115–119 vs. 99 in *Lycodon davidi* spec. nov.) and more ventrals in males (232–237 vs. 224 in *Lycodon davidi* spec. nov). In addition, *Lycodon multifasciatus* has nearly uniform pale ventral surfaces of the body (vs.



Figure 3. Holotype of *Lycodon davidi* spec. nov. in life, IEBR A.2011.7, from Nam Cave, Vang Vieng, Vientiane Province, Laos (Photo by T.Q. Nguyen).



Figure 4. *Lycodon ruhstrati abditus* from Hunan Province, China, in life (Photo by Mian Hou).

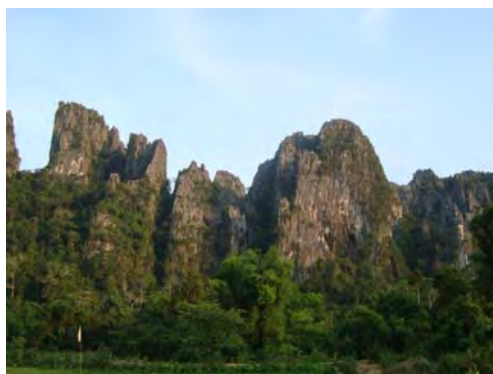


Figure 5. Habitat of *Lycodon davidi* spec. nov. in Nam Cave, Vang Vieng, Vientiane Province, Laos (Photo by T.Q. Nguyen).

Table 1. Important characters of males in the *Lycodon rufistrati* group¹

Character	<i>Lycodon danfui</i> spec. nov.					<i>L. rufistrati</i>	<i>L. r. abditiis</i>	<i>L. ophiophagus</i>	<i>L. futsingensis</i>	<i>L. multifasciatus</i> ²	<i>L. paucifasciatus</i>
	<i>L. r. rufistrati</i>	<i>L. r. abditiis</i>	<i>L. ophiophagus</i>	<i>L. futsingensis</i>	<i>L. multifasciatus</i> ²						
Rel TL, males	0.220-0.248 N=7	0.202-0.230 N=5	0.201 N=1	0.194-0.228 N=13	0.25 N=?	0.204 N=1					
VEN, males	211-228 N=8	206-224 N=9	211 N=1	193-203 N=14	232-237 N=3	221 N=1					
SC, males	105-114 N=7	91-97 N=5	92 N=1	72-85 N=13	115-119 N=3	92 N=1					
Body bands	33-46 N=19	30-47 (19) N=19	21-22 N=2	19-33 N=21	51-80 N=11	24-25 N=2					
Tail bands	14-25 N=19	10-19 N=13	13-14 N=2	9-18 N=20	25-42 N=20	11 N=2					
First band	8-14 N=19	9-17 N=15	28 N=1	13-23 N=18	7-11 N=2	10-15 N=2					
Broad base	5-7 N=19	5-12 N=15	8 N=1	5-10 N=18	about 6 N=1	9.5-11 N=2					
Lo entering orbit	No N=38	No (rarely yes ³) N=38	No N=2	No N=42	No N=11	No N=4					
Color of the venter	More or less uniform in most specimens, some speckled in the posterior part. Posterior part pale N=19	More or less uniform in some specimens, most speckled in the posterior part. Posterior part pale N=15	Anterior third whitish-cream, posterior part heavily speckled with dark dots N=1	More or less uniform in some specimens, most speckled in the posterior part. N=21	Uniform with few scattered speckles. Posterior part pale N=1	One specimen slightly speckled, the other specimen anterior little speckled posterior much. Posterior part pale N=2					

1: Only specimens that could be examined by us were used for the table with the exception of *L. multifasciatus*

2: from Ota (1988), Mori (1984) and FMNH 233135 (female)

3: in 6 specimens, all from Fujian the tip of the loreal enters eye.



Figure 6. Map showing the type locality of *Lycodon davidi* spec. nov. IEBR A.2011.7, in Vang Vieng District, Vientiane Province, northwestern Laos.

heavily speckled in *Lycodon davidi* spec. nov.) and tail (more or less uniformly pale in *L. multifasciatus* vs. heavily speckled in *Lycodon davidi* spec. nov.).

All species of the *Lycodon fasciatus* group differ from *Lycodon davidi* spec. nov. in the banded venter, the lower number of bands on the body, and the loreal entering orbit (except *L. synaptor* Vogel & David, 2010).

Lycodon davidi spec. nov. differs from the other Chinese and Indochinese species as follows: from *L. subcinctus* Boie 1827 by the presence of both, loreal and preocular; from *L. laoensis* Günther 1864, *L. zawi* Slowinski, Pawar, Win, Thin, Tun, Gyi, Oo & Tun, 2001 and *L. capucinus* Boie, 1827 by the cloacal shield undivided (vs. divided in the latter three species). Furthermore, its colouration is much different.

It differs from the Indian species *Lycodon flavicollis* Mukherjee & Bhupathy, 2007, *Lycodon flavomaculatus* Wall, 1907, *Lycodon jara* (Shaw, 1802), *Lycodon mackinnoi* Wall, 1906, *Lycodon tiwarii* Biswas & Sanyal, 1965 by the fact that it is banded through the whole of its body whereas these species are not or only partly banded. *Lycodon striatus* (Shaw, 1802) has a different colouration and fewer subcaudals (less than 58 in contrast to about 99 in

L. davidi), *Lycodon travancoricus* (Beddome, 1870) has fewer subcaudals (64-76 against around 99), fewer ventrals (176-206 against around 224) and a different colouration with yellow bands.

From *L. paucifasciatus* Rendahl, 1943, another species occurring in Vietnam, *Lycodon davidi* spec. nov. differs by having fewer anterior dorsal scale rows (17 vs. 19 in *L. paucifasciatus*) and more bands on the body (84 against 14-25 in *L. paucifasciatus*).

Despite the fact that no investigations in the relationships of this genus have been done, we provisionally assign this species into the *Lycodon ruhstrati* group, due to morphological similarities. This group contains *L. ruhstrati ruhstrati*, *L. ruhstrati abditus*, *L. multifasciatus*, *L. ophiophagus*, *L. paucifasciatus*, and *L. futsingensis* (see Vogel et al. 2009). None of the members of this group has been reported from Laos so far but at least *L. futsingensis* and *L. paucifasciatus* were recorded in Vietnam close to the border of Laos and these species are also expected to be found in Laos in the future.

Lycodon davidi spec. nov. seems to be associated with limestone habitat. The karst forests are well known for their high level of local endemism (Clements et al. 2006). The Asian limestone karst hills have been a target of recent herpetological research and many new species, especially of lizards (e.g., Hoang et al. 2007, Ngo & Grismer 2010, Grismer 2010, Ziegler et al. 2010), as well as some new snake species (e.g., Orlov et al. 2004, 2009) have been described from such habitats. In particular, Laos has a large karst area (approximately 30,000 km²) and its herpetofauna is poorly studied. However a number of new species has been discovered in the last two years (Ngo & Pauwels 2010, Nguyen et al. 2010, David et al. 2011, Schneider et al. 2011). The relatively poor level of zoological surveys of karsts is very unsatisfactory, keeping in mind that karst hills are widely exploited for limestone, an important mineral with many industrial uses (Clements et al. 2006).

At present, five species of *Lycodon* species are known from Laos: *L. capucinus*, *L. fasciatus*, *L. laoensis*, *L. subcinctus*, and *L. davidi* spec. nov.

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APPENDIX I. Additional material

Lycodon futsingensis (23 specimens): BM 1983.203, Lantau Island, Hong Kong, China; AMNH 34105 (paratype), Fukien (now Fujian Province), China; IEBR A.0822, Yen Tu, Luc Nam, Bac Giang Province, Vietnam; MNHN 1938.130, Ngan Son, Bac Kan Province, Vietnam; ZFMK 81474, Ha Tinh, Ha Tinh Province, Vietnam; IEBR A.0704, Cat Loc, Lam Dong Province, Vietnam; ZFMK 86453, Phong Nha - Ke Bang National Park, Quang Binh Province; IEBR A.0821 (AMNH FN 16799), A Roang, A Luoi, Thua Thien - Hue Province, Vietnam; IEBR A.0705, IEBR A.0760-A.0761, IRSNB 17281 (formerly PSGV 590), IRSNB 17282, MNHN 1935.0099-0100, MNHN 2006.0437-0439, PSGV 676-1/2, PSGV 760, ZFMK 59232, Tam Dao, Vinh Phuc Province, Vietnam; AMNH R153709 Van Ban District, Lao Cai Province, Vietnam.

Lycodon ophiophagus (2 specimens): QSMI 0596 (holotype), Lamru Waterfall, Khao Lak-Lamru National Park, Phang-Nga Province, southern Thailand; IRSNB 2611 (paratype), near Klong Hat Som Paen, Muang District, Ranong Province, southern Thailand.

Lycodon paucifasciatus (2 specimens): ZFMK 80662, ZFMK 86452, Phong Nha - Ke Bang National Park, Quang Binh Province, Vietnam.

Lycodon ruhstrati ruhstrati (19 specimens): NMW 22794:1-16, 18, "Suishario", now Shui-she-liao, Taiwan; FMNH 14067-14068, Yang-ming-shan, Ping-tung Hsien, Taiwan.

Lycodon ruhstrati abditus (15 specimens): ZFMK 86451 (holotype), U Bo region, Phong Nha - Ke Bang National Park, Quang Binh Province, Vietnam; ZFMK 23363 (paratype), "Kuatun", now Guadun, Chong'an County, Fujian Province, China; ZMB 65454 (paratype), "Laung Tao Shan", now Longtou Shan, Guangdong Province, China; MNHN 2006.0436 (paratype), Tam Dao, Vinh Phuc Province, Vietnam; FMNH 24876, Ch'ungan Hsien, Fukien (now Fujian Province), China; FMNH 250793, Sichuan Province, China; CIB 9810-9814, Fujian, China; CIB 9819, CIB 9816, CIB 78123, CIB 83750, Szechuan (now Sichuan Province), China.

Lycodon multifasciatus (1 specimen): FMNH 233135, Yaeyama Group, Ishigaki-jima Island, Ryukyu Islands, Japan.

Specimens of the *Lycodon fasciatus* group used for comparisons were listed in Zhang et al. (2011).

APPENDIX II. Characters used**Morphometry**

- Snout-vent length (mm)
- Tail length (mm)
- Total length (mm)
- Relative tail length TaL/TL

Anatomy

- Number of upper maxillary teeth (on one side) (not counted in every specimen)

Scalation

- Dorsal scale rows at neck (at 1 head length behind head)/ at midbody/ before vent
- Number of keeled dorsal rows
- Ventral plates
- Number of preventrals
- Ventrals notched or keeled or none of these
- Subcaudal plates
- Cloacal (anal) plate: 1: single and 2: divided
- Number of loreal scales at left/right
- Loreal scale touching eye at left/right
- Number of supralabials at left/right
- Numbers of the SL entering orbit at left/right
- Largest SL left/right
- Number of infralabials at left/right
- Total number of infralabials
- Number of IL in contact with anterior chin shield
- Number of preoculars at left/right
- Number of postoculars at left/right
- Number of anterior temporals at left/right
- Number of posterior temporals at left/right
- Temporal row containing the paraparietals
- Plates surrounding the paraparietals, see Inger & Marx (1965)
- Scales between the paraparietals

Pattern

- Body colour
- Number of bands on body
- Number of bands on tail
- Colouration of tail venter
- Banding of belly
- Speckling of belly
- Number of VEN before the first band starts, counted left side
- Number of VEN that are covered at the base of the first band
- Numbers of vertebral scales that are covered by the first band
- Dorsal bands with light margins
- Colour of the throat
- Number of VEN that are covered at the base of the last band before cloacal shield